PATENT COOPERATION TREATY

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INTERNATIONAL SEARCHING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2004/051643	28.07.2004	28.08.2003

International Patent Classification (IPC) or both national classification and IPC
H04L1/06, H04L25/02, H04L27/26

Applicant
MOTOROLA INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/EP2004/051643

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	16
Inventive step (IS)	Yes:	Claims	6-8,11
	No:	Claims	1-5,9,10,12-16
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Cited documents:

Reference is made to the following documents:

D1: US 2002/041635 A1 (MA JIANGLEI ET AL) 11 April 2002 (2002-04-11)

D2: WO 02/45329 A (ERICSSON TELEFON AB L M) 6 June 2002 (2002-06-06)

D3: MUQUET B ET AL: "OFDM with trailing zeros versus OFDM with cyclic prefix: links, comparisons and application to the HiperLAN/2 system" ICC 2000. 2000 IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS. CONFERENCE RECORD. NEW ORLEANS, LA, JUNE 18-22, 2000, IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, NEW YORK, NY: IEEE, US, vol. 2 OF 3, 18 June 2000 (2000-06-18), pages 1049-1053, XP002231869 ISBN: 0-7803-6284-5

D4: DENEIRE L ET AL: "TRAINING SEQUENCE VERSUS CYCLIC PREFIX-A NEW LOOK ON SINGLE CARRIER COMMUNICATION" IEEE COMMUNICATIONS LETTERS, IEEE SERVICE CENTER, PISCATAWAY,US, US, vol. 5, no. 7, July 2001 (2001-07), pages 292-294, XP001103154 ISSN: 1089-7798

Claim 1

1 The subject-matter of claim 1 does not involve an inventive step (Article 33(3) PCT).

Document D1 discloses a method of communication using Orthogonal Frequency Division Multiplexing from a transmitter comprising a plurality of transmit antenna means and a receiver comprising at least one receive antenna means (page 2, left-hand column, paragraph 23 - right-hand column, line 1), the method comprising generating bit streams and corresponding sets of N frequency domain carrier amplitudes modulated as OFDM symbols subsequently to be transmitted from a transmitter, where k is the OFDM symbol number and j indicates the corresponding OFDM carrier number, inserting affix information into guard intervals between consecutive time domain OFDM symbols, transmitting said time domain OFDM symbols including said affix information from said transmitter to said receiver (Fig. 1), using said affix information at the receiver to estimate the Channel Impulse Responses of the transmission channels between said

transmitter and said receiver, and using the estimated Channel Impulse Response to demodulate said bit streams in the signals received at said receiver (Fig. 7), and wherein
said affix information is known to said receiver as well as to said transmitter (page 3, paragraph 37), and is mathematically equivalent to a vector that is common to said time domain OFDM symbols multiplied by weighting factors that enable one of said transmit antenna means to be distinguished from another (page 3, paragraph 37).

The subject-matter of claim 1 differs from document D1 in that the symbol is multiplied by at least other weighting factors that are different for one time domain OFDM symbol than for another.

The problem to be solved by this solution can be considered as to achieve the framing of the transmitted signal.

This problem is well-known in the art and there are several alternatives known to a skilled person to solve such a problem, e.g. create affixes out of the OFDM symbol itself like introducing cyclic affixes, multiply the OFDM symbol by a factor etc.. Therefore, a skilled person only has to choose from a number of equally likely alternatives. So, the solution to the problem is only a design feature without any inventive merit (Guidelines C-IV-Annex, 3.1)

2 It is noted, that the above objections could have alternatively been raised on the basis of Document D2 (page 13, line 24 - page 14, line 26), which discloses the same type of method as disclosed in D1.

Claims 15 and 16

3 As far as understood from the wording of the claim, the subject-matter of claim 15 corresponds to the subject-matter of claim 1. Therefore, the subject-matter of claim 15 does not involve an inventive step for the same reason as claim 1 (Article 33(3) PCT).

4 Claim 16 specifies a normal OFDM receiver as mentioned in documents D1 or D2

(see also paragraph 15). Therefore, the subject-matter of claim 16 is not new (Article 33(2) PCT).

Dependent Claims 2-5,9,10,12-14

5 The dependent claims 2-5,9,10,12-14 do not contain any additional features which, in combination with the features of the claim to which they refer, meet the requirements of the EPC with respect to novelty and inventive step because these features are either known from the above prior art or common measure; e.g. Claims 2-5,9,10,12-14: common knowledge or simple design features

Dependent claims 6

6 Claim 6 adds to claim 1 that the vector $\mathbf{c}_D$ is encoded by a second specific space-time encoder **W** such that the encoder produces M affixes for each of the N_t transmit antennas corresponding to said affix information weighted by said first and second weighting factors.

7 The problem to be solved by these features is to realize a channel estimation in a MIMO-OFDM without inserting additional redundancy to the system and to have the advantages of Zero Padded (ZP) OFDM systems.

8 In document D1 a preamble is inserted after the space-time encoding of the OFDM symbol. This preamble is a PN sequence and is used as a training sequence. But there is no hint in the prior art that the PN sequences or the preambles are also space time coded by a separate space time encoder. It is not obvious to a skilled person to adapt the system of D1 in such a way to arrive at the solution of the application, since the introduction of a second space time encoder for the PN sequence means a higher effort for the whole system.

9 As in D1, in D2 no second space-time encoder is used for the prefixes.

10 Document D3 discloses SISO-systems with cyclic prefix insertion for OFDM and with trailing zero insertion for OFDM.

11 Document D4 discloses a single carrier system wherein the cyclic prefix is used as a training sequence.

12 For these reasons, the subject-matter of claim 6 involves an inventive step (Article

33(3) PCT).

Dependent claims 7, 8 and 11

13 Claims 7, 8 and 11 are truly dependent on claim 6. Consequently, these fulfil the requirements of novelty and inventive step (Articles 33(2,3) PCT) for the same reasons as claim 6.

Further remarks:

14 Claim 1 does not meet the requirements of Article 84 EPC because its category is not clear:

In contrast to the wording of the preamble which suggests the definition of a method, the features in the characterising portion of the method Claim 1 are not method steps. The claim tries to define the affix information by its characteristics and not by the method steps necessary to carry out.

Consequently, the category of Claim 1 is not unambiguously defined and the Applicant should thus clarify Claim 1 accordingly in view of Article 84 EPC.

15 Despite their reference to previous claims, the device Claims 15 and 16 have to be considered independent, since they claim a transmitter respectively a receiver and not a method as is the case for all the previous method claims.

It is noted that a claim may contain a reference to another claim without necessarily being a dependent claim (see PCT Guidelines, 5.15). In particular, a claim referring to a claim of another category (such as a device claim referring to a method claim) is, per definition, an independent claim.

The fact that Claim 15 and 16 refer to the previous method claims simply means that the devices are suitable for being used with such methods, without necessarily defining the means which are required (see also PCT Guidelines, 5.23).

Therefore, even when retaining the reference to the previous method claims, Claims 15 and 16 should be amended in order to contain all the essential features necessary to carry out the invention as required by Article 6 in combination with Rule 6.3(b) PCT.

16 In claim 6 it is unclear if the reference means "as claimed in any preceding claim" or "as claimed in claim 1" (Article 6 PCT).

17 Claim 9 refers back to "any preceding claim". But the matrix W is not defined in all preceding claims especially not in claims 1 to 5 (Article PCT).

18 In claim 10 an antecedent definition for "the received signal $\mathbf{d}_m$" is missing (Article 6 PCT).

19 On page 4, line 8 a reference to the modulator of Figure 2 is made. But Figure 2 shows a receiver. The modulator is shown in Figure 1.

20 On page 5, line 22 it should be "converter 5" instead of "converter 6".

21 On page 5, line 26 it should be "converter 6" instead of "converter 7".

22 To meet the requirements of Rule 5.1(a)(ii) PCT, the document D1 should be identified in the description and the relevant background art disclosed therein should be briefly discussed.

23 The features of the claims have not been provided with reference signs placed in parentheses to increase the intelligibility of the claims (Rule 6.2(b) PCT).